Minos D, Butzlaff I, Demmler MK, Rischke R.

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***Current Obesity Reports* 2016, 5(4), 441-448.**

Economic Growth, Climate Change and Obesity

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ABSTRACT

Human and planetary health as well as economic growth are firmly interlinked and subject to complex interaction effects. In this paper, we provide an overview of interlinkages between economic growth, climate change, and obesity focusing on recent advances in the literature. In addition to empirical findings, we discuss different theoretical frameworks used to conceptualize these complex links and highlight policy options and challenges. We conclude that policies addressing both climate change and obesity simultaneously are particularly promising and also suitable for ensuring sustainable development.

Keywords: Obesity, Economic Growth, Climate Change, Sustainable Development

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August 2016

Introduction

Climate change and obesity hold a prominent role in current debates on sustainable development, since both consider the adverse effects of economic development and both are argued to hamper economic growth [1]. Moreover, the economic costs of non-communicable diseases and environmental degradation have been well documented [2;3]. More recently, research has established another link arguing that obesity is both a cause and consequence of climate change. The interlinkages of these relationships are difficult to disentangle and causality runs in all directions [4]. Figure 1 provides an overview of the interconnectedness of economic growth, climate change and obesity, as well as some of the transmission channels suggested in recent literature.

Figure 1: Linking economic growth, climate change and obesity

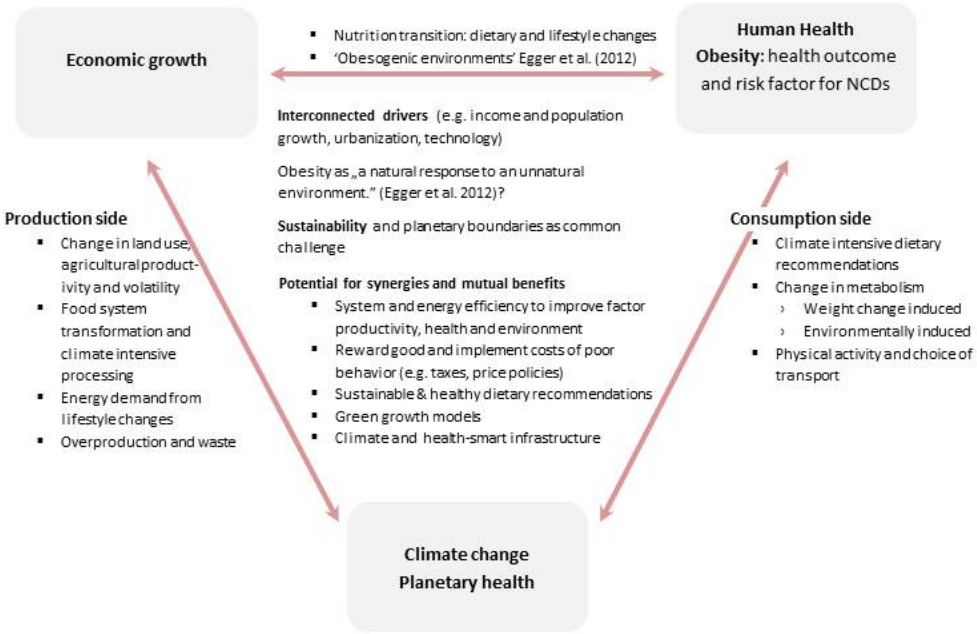

Figure 1 provides an overview of the interconnectedness of economic growth, climate change and obesity, as well as some of the transmission channels. This framework is developed from the listed literature and emphasizes three links (depicted as a triangle) as well as mutual (and mutually reinforcing) drivers, challenges, and potential synergies (depicted inside the triangle). The purpose of this paper is to summarize some of the recent advances in research that shed light on these complex relationships. As is discussed in section 2, economic growth is linked to human health and obesity by affecting diets and lifestyles, while obesity and health affect economic performance for example through the channel of labor productivity. Section 3 examines the link between economic growth and climate change. Focusing on the production

side, it is assumed that increased production can spur climate change and environmental degradation. At the same time, climate change itself, as well as adaptation and mitigation strategies affect economic growth. For understanding the dynamics involved, it is useful to explicitly consider the demand and consumption side induced by (aggregated) individual behavior, which is addressed in section 4 and describes the links between health outcomes and climate change. Section 5 highlights policy options that address both climate change and obesity, while ensuring sustainable development.

Economic Growth and Obesity: What have we learned in recent years?

The main argument that drives the discussion in its most simplistic form is that higher obesity levels are part of the development process and a result of declining food prices and rising incomes, so that individuals can financially afford to consume higher quantities of food. However, this seems to be an oversimplification of two extremely complex phenomena. Therefore, researchers are trying to investigate further transmission channels, while the positive association itself is also disputed and increasingly more authors also address the issue of reverse causality and the negative effects of obesity on growth [5].

Obesity is the result of an imbalance between energy intake and expenditure. The main theoretical link provided in the literature is that economic development and technological change alters food prices, the structure of the economy and disposable incomes [6]. The model predicts demand induced increases in body weight through the affordability and availability of energy dense foods, but also increased opportunity costs and therefore decreased demand for energy expenditure. This framework conceptualizes some of the opposing forces at work, which can be seen as a result of increasing incomes. Empirical investigations show that periods of economic downturn are followed by a reduction in obesity rates based on the example of Cuba [7]. Others argue that prevalence rates of obesity rise as incomes increase until a certain threshold is reached. Beyond that threshold, the relationship is negative giving an inverse-U shaped curve [8]. Aggregate data from the US show in in a fixed-effects estimation that this relationship can be confirmed for white women. However, these results only show patterns that emerge in the US and for a certain population group. Nevertheless, a similar positive concave relationship emerges for women using DHS (Demographic and Health Surveys) data [9]. However, this finding only seems to hold for middle-income countries and not for poorer ones. All of this suggests that different mechanisms may be in place around the world and that a growing economy may even facilitate a reduction of obesity rates in low- and middle-income countries after controlling for unobserved heterogeneity and time-fixed-effects [10]. The size of the country fixed-effects can vary substantially suggesting that policy options are difficult to generalize and that case studies may provide a clearer picture.

Several transmission channels related to economic development are explored in the literature. Obesity rates are argued to be driven by certain types of economic development [11]. The "Neo-liberal Diet Risk Index" for example includes measures for food import dependency, income inequality, urbanization, female labor force participation and the KOF (Konjunkturforschungsstelle) Index of globalization and the risk of being exposed to this type of diet has increased between 1984 and 2007 in the US and also for a number of other countries. Moreover, it is mostly lower economic classes that are exposed to dietary risk. Another transmission channel is trade liberalization, which can be seen as both a cause and consequence of economic development. The Index of Economic Freedom is used to investigate the hypothesis that market deregulation allows for higher penetration of high-processed energy dense food items in diets [12]. Data from 25 OECD (Organization for Economic Cooperation and Development) countries and instrumental variable techniques estimate that lower market barriers increase the number of fast food transactions and thus average body mass. However, actual consumption data from the US, the UK and France suggest that it is rather an interaction of economic environment, food prices and preferences that accounts for differences in consumed quantities and the composition of food baskets [*13].

However, the channels identified for industrialized countries may not apply in the developing world. Data collected in Kenya are used to analyze dietary impacts of the increased penetration of supermarkets [14]. Supermarkets have substantially increased the availability of energy dense foods and drinks. The distance of a household to the nearest supermarket serves as an instrument and the conclusions indicate that calorie availability and the consumption of processed foods have notably increased among supermarket customers. The same dataset shows that this affects nutritional outcomes across different age groups [15].

With regard to physical activity, researchers have investigated the relationship between the living environment and opportunities for physical activity [16]. An important feature of these new approaches is that the environment is defined as multidimensional and can be affected in many ways by economic development, while it can also affect physical activity through various channels. Both qualitative and quantitative data are used to determine potential barriers or opportunities presented by the environment in four communities in Alberta, Canada. The analysis suggests that the physical (e.g. availability of gyms, sport facilities etc.) and sociocultural environment (safety, car culture, motivation for physical activity etc.) play a much larger role compared to the economic (affordability, governmental financial support etc.) and political environment (community programs, regulation etc.).

It is becoming clear that the growing literature on obesity highlights the complexity of the links between economic growth and obesity. Several channels have been uncovered so far and new

research avenues have been opened. However, the results are not easily generalized and different mechanisms or channels may prevail in different countries. Moreover, most of the results only apply for certain population groups making it difficult to draw appropriate policy implications. Nevertheless, continued research will provide a clearer picture, which will help shape the necessary policies in addressing the phenomenon.

Economic growth and climate change

In the early 1990s studies found that climate change would only have a limited impact on world agricultural markets, though with diverging effects across regions. Scientists concluded that from a global perspective, markets are not severely affected, partly because of international trade, and that further economic growth would not be hindered [17;18]. Later, the picture has changed substantially and climate change has been found to have an impact on agricultural output. Food production has become unpredictable in some regions of the world due to climate change and global food security is endangered by rising temperatures [19]. Climate change is argued to affect food availability, economic access, utilization, and the stability of (global) food systems and finally leads to hunger and undernutrition in some regions, especially in low-income and transition countries including India, Eritrea and Burundi [** Wheeler T and von Braun J. Climate Change Impacts on Global Food Security. Science. 2013. 341:6145, 508-513 (DOI:10.1126/science.1239402)]. Different economic models intend to capture the complex effect of endogenous responses to different climate change scenarios [21]. The responses include adjustments in consumption, yields, area and international trade. Results indicate that climate change not only reduces yields, but also cause prices to rise, which may lead demand to shift to other goods. A common feature of all tested models is that they transfer a large part of the climate change shocks to the production side and to trade responses. In particular, climate change is expected to especially hurt people living in developing countries who often are already threatened by food insecurity.

Additional transmission channels relate to how economic growth affects people and their wellbeing, and more specifically, how economic growth has an influence on climate change. Rising incomes result in increased demand for energy, infrastructure, urbanization and lifestyle changes [22]. All of these developments cause GHG emissions and hence contribute to increasing global temperatures. One mega-trend that has potentially profound nutritional implications is the globalization of agri-food systems [23]. The westernized diets and sedentary lifestyles associated with the nutrition transition include highly processed foods and convenience products that lead not only to increased GHG, but also to rising levels of obesity. In the Intergovernmental Panel on Climate Change (IPCC) report [24], it is clearly stated that

"demand-side measures [to mitigate climate change] include dietary change and waste reduction in the food supply chain". It is also indicated that these kinds of measures are under-researched and that the potential for change in diet and food production is significant but uncertain in magnitude. Some scientists more clearly emphasize that the current food system is harmful to the environment, arguing that food production is estimated to contribute 20-30% of anthropogenic GHG emissions, and is the leading cause of deforestation, land use change and biodiversity loss [*25; 26]. At the same time it is estimated that 30-50% of global annual food production is wasted [*27]. Livestock production not only contributes to climate change, but also causes health risks posed by the global growth in (cattle) meat production and consumption [26]. Moreover, it is emphasized that obese people consume relatively more food (e.g. fats and refined sugars which are particularly carbon intensive) and that more organic waste increases methane (CH4) emissions [28]. Agriculture not only contributes to climate change through CO2 emissions, but also through methane emissions (CH4), which are a key component of GHG emissions. CH4 emissions stem from livestock and rice cultivation, among others. GHG emissions intensities of major AFOLU (Agriculture, Forestry and Land Use) commodities clearly identify cattle meat as the main source of GHG emissions [24]. The agricultural sector is estimated to be the largest contributor to global anthropogenic non-CO2s, contributing 56%. Regarding all GHG emissions, the AFOLU sector is responsible for around 25% [24]. The following section will discuss in more detail how healthy diets could help to reduce obesity on the one hand, and result in a lower environmental footprint on the other.

Climate change, food choices and obesity

Dietary choices are one of the main factors influencing both the environment and health, and are often not separable. During the early stages in life, individual food choices and the amount of food which is consumed are shaped through social, biological and living-environmental factors. Later in life, factors influencing food choices become more complex and depend on age, sex, education, income and health [29]. The overconsumption of meat and animal sourced products displays a problem not only for the onset of obesity and other NR-NCD (Nutrition-Related Noncommunicable Diseases) [30], but also for the environment as we have seen that livestock is the main contributor of GHG emission in the agricultural sector [31;*32;*33].

Comparative risk assessment models in four dietary scenarios are used to estimate region-specific mortality on the basis of coronary heart diseases, stroke, type 2 diabetes mellitus and cancer. It is indicated that a 'healthy global diet', defined by a minimum of five portions of fruits and vegetables, low-sugar contents and a maximum of 43 grams of red meat per day, would result in approximately 5 million avoided deaths per year and a projected food-related reduction

in GHG emissions by almost 30% compared to a reference diet[1] in 2050 [*33]. The projected outcomes on health and environment can mainly be attributed to the reduction in meat consumption. Other researchers use biophysical models to estimate environmental effects of a diet which includes a 50% reduction in the consumption of beef, dairy, pork, poultry, and egg consumption, which is augmented by an increased cereal intake compared to a reference diet for the EU27[2] [30]. The authors conclude that a diet with such a reduction in meat compared to the reference diet would decrease net GHG emissions related to EU agriculture production by 42% [Westhoek H, Lesschen JP, Rood T, Wagner S, De Marco A, Murphy-Bokern D, Leip A, van Grinsven H, Sutton MA and Oenema O. Food choices, health and environment: Effects of cutting Europe's meat and dairy intake. Glob Environ Change. 2014. 26, 196-205 (DOI:10.1016/j.gloenvcha.2014.02.004).

Consequently, a global reduction in meat consumption, with a greater share of vegetables, fruits and cereals, could help to make dietary choices more environmentally sustainable and hence more climate and health friendly. But the setup of a sustainable diet is more complex, as sustainability should not only be aligned to environmental and nutritional goals, but also to social and in some cases economic goals. Since meat is not the only contributing factor to GHG emissions, it is also of great importance to include the environmental factors of other foods in the analysis. Therefore, some general recommendations in addition to dietary diversity and energy balance were given [*25]. It is argued that a sustainable diet should be based on (predominantly) unprocessed whole grains and tubers with the exception of rice, which is likely to have higher GHG emissions [*25]. Further, on robust and field grown fruits and vegetables, moderate dairy, sparing meat consumption, some fish and aquatic products if possible out of sustainable production, unsalted seeds and nuts and include limited consumption of sugary and fatty sweets, snacks and beverages [*25]. Although, these guidelines are rather broad and need to be placed in cultural and regional contexts, they can help to rethink existing dietary recommendations, especially regarding certain fruits and vegetables, rice and fish consumption [*25;34].

Food consumption is not only about the quality and choices people make, but it is also about the quantity (and the safe handling of food). Human energy requirements depend on weight, genetics, age and gender [35]. Hence, obesity itself is likely to increase overall food consumption,

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1 Reference diet based on projections from the Food and Agriculture Organization of the United Nations for 2015

2 EU27, 27 European Union Member States (before June 2013) included: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom

as increased weight leads to a higher basal metabolic rate (besides overall metabolic changes) and therefore to a higher food demand [31]. An overweight population could have an estimated 16-19% higher food energy requirement compared to a normal weighted population, which would result in an increase in GHG emissions [36]. However, one might find reasons to criticize the approach as oversimplified [*25]. Others denounce methodological mistakes and their "unacceptable blaming and stigmatizing message", while noting that it is not only obese people but the population as such that contributes to rising GHG emissions [37]. Nevertheless, studies such as this one provide arguments that people's weight, food choices and the quantities they consume, do have an influential impact on the environment.

A further assumption concerns the relation between obesity and transportation and the additional fuel used in cars and in airplanes due to a heavier population, which results in greater GHG emissions [31;36]. This connection is based on the assumption that obese people tend to walk less and therefore car usage will increase [*27].

Looking at the impacts of climate change on health and obesity; A possible relationship between a temperature increase and a lower brown adipose tissue activity could be established [38]. Since brown adipose tissue is essential for the thermogenic capacity of a person, a loss in its activity is directly related to a lower basal metabolic rate and hence to possible obesogenic impacts [38]. Other studies also claim that climate change has effects on health mainly through physical hazards, temperature extremes, air quality and pollution [31;*27].

How does it all fit together?

As we have seen, human and planetary health, as well as economic growth, are firmly interlinked and thus subject to complex interaction effects [4;39]. These linkages can be seen as different challenges including: first, to ensure food security and access to clean drinking water for all; second, to ensure sustainable economic development; and third, to counter the negative effects of NCDs (Noncommunicable Diseases) [*40]. Malnutrition in all its forms, may it be in terms of over- or under-consumption of certain nutrients, implies unsustainable development [41], which can be through the channel of energy inefficiencies or health related productivity losses that are expected to negatively affect economic growth and well-being in the long-run.

Differentiating between production and consumption channels, while recognizing overlaps, is one way to think about the different needs and angles for action, e.g. related to food systems or to aspired lifestyles. Economic growth is suggested to be linked to health through an *individual* pathway related to lifestyle and dietary changes that play out in 'obesogenic' or 'enabling environments' [4;42], and through a *global* pathway that is related to environmental effects and climate change. Other ways of conceptualizing these interactions include considering direct and

indirect effects of human action or economic growth [*27;39], focusing on societal context factors and policy actions [42] or actors of change and intervention opportunities [43].

No matter what the framework is, we are in the process of overstretching planetary and increasingly social boundaries [*27;*32], and increasing life expectancies seem to have become decoupled from increasing 'healthy lifespans' [*40]. Acknowledging the complexities and stakes involved, the need for a systemic approach has been reaffirmed [*40;42;44]. It is much less evident how such a system change, as well as the process of achieving it, should look like.

Using technology as an example: it is unclear what role it can and should play in tackling global challenges. Employing 'smart technologies' to increase energy efficiencies along the production and consumption chains certainly holds great potential [*40;43]. Agricultural technologies including bio-fortification and genetic engineering are further argued to be one strategy *required* to ensure food security for all [23]. At the same time, technological advances and increased energy efficiency are not sufficient to reduce adverse environmental effects, e.g. due to rebound effects that increase the net energy consumed [*27;45].

A rather constructive way of looking at the inter-linkages described is thinking in terms of co-benefits that can arise from addressing specific 'nodes in the system'. A 'health dividend' can be realized, for example, from reducing air pollution [*27;46], and dietary changes towards more sustainable dietary guidelines can improve health alongside reducing GHG emissions [5;*33;47].

At the same time, we are aware of the substantial barriers to change. Strong social and physiological factors are at play, including bounded rationality and improper time discounting, which hinder individuals to change behavior despite knowing of the associated benefits [48]. On a more aggregated level, inertia of tackling global problems, spurious accountabilities and questions of intergenerational justice meet the political reality of short-term election cycles and vested interests.

What policies could generate co-benefits?

The relevant policy areas include three pillars, namely food security (i.e. physical, economic, safe, and stable access to healthy food) [49], health and sustainable, or 'green' growth. As we have seen before, meat-rich diets tend to have a larger environmental footprint [5]. Some authors suggest that reducing global demand for meat and dairy products is in fact necessary to meet the climate goals reinforced by the Paris Agreement in 2015 [50]. The Chinese government's recent plan to reduce China's meat consumption by half is a promising example in this respect [47].

Regarding the pillar of health and obesity prevention in particular, some researchers advocate 'smart food policies' that create 'enabling environments' for developing healthy food preferences and for making healthy food choices [42]. By emphasizing that healthy choices should not merely be the easy, but also the preferred option, they go beyond the 'nudging approach' rooted in behavioral sciences [42]. Discussing many examples provided by the OECD and other countries, the role of behavioral sciences in creating influential 'choice architectures' relevant for all pillars identified can be illustrated, while addressing concerns of governmental paternalism.

For the case of Australia, a country characterized by high p.c. GHG emissions and high obesity rates, the most promising policy options seems to be comprised of a reduction of car usage while encouraging an active mode of transport, improving diets and reducing emissions from the food system, and macro-level policies to reduce over-consumption that include tackling high-rates of income inequality [42]. The proposed policies include improved food standards and nutrition education at schools, economic instruments such as taxes and subsidies and nutrition labelling to increase consumer awareness [42].

Implicit in a systematic approach and explicit by global initiatives, such as the Sustainable Development Goals or the Paris Climate Agreement, is a need to rethink the current growth framework that we have seen to be associated with overconsumption and climate change [4;*40;51]. There is no consensus on what 'sustainable development' or 'green-growth' entails and in particular, if it necessitates positive *economic* growth rather than growth in some alternative measure of well-being[3]. In any case, green-growth goes beyond incentivizing good behavior and correcting market failures to internalize the 'true' social costs of environmental degradation and poor health. A green-growth framework would enable dietary improvements and healthier lifestyles as a means to economic growth rather than an end [5].

An end in itself and a factor associated with instrumental importance for behavioral change is knowledge and education. While we have established before that knowledge is not sufficient [53], addressing knowledge gaps and misconceptions play an integral role in the theories of change [42;54]. Based on cross-national surveys it can be shown that there is a major awareness gap about the contribution of meat and dairy production to anthropogenic climate change [50]. At the same time, the authors find the willingness to take individual action to be stronger among individuals aware of climate impacts. One challenge in climate and health-related knowledge and awareness programs again relates to the complexities involved: people are more likely to respond to messages that are easy, attract attention, are appealing to a broad social spectrum

3 see for instance OECD 2011 vs. UNEP 2011 definition of sustainable growth.

and are timely [55]. Yet, a certain level of system knowledge is required to link one's meat consumption patterns, for example, to problems of environmental degradation in a different location and to global consequences more generally.

Conclusion

What should we take away from this? Climate change, obesity and the path to achieving sustainable growth are complex matters that require multi-facetted solutions. There is huge potential for synergies in addressing climate change and obesity that are further expected to agree with achieving sustainable growth.

Research methods and simulation approaches are becoming ever more powerful in predicting environmental and health trends and their impacts at regional levels [*33]. However, in order to build on these studies to design policies, we need to keep in mind the uncertainties and potential non-linear interaction effects involved [*27], and not fail to account for context and even target group specific factors that may interact with different impact mechanisms.

It is of course, of utmost importance to work towards closing data and research gaps [41], yet we need to be more proactive in initiating change under uncertainty and imperfect information [*27]. In doing so, we should capitalize on existing potential and knowledge. For example, it is well established that GDP (Gross Domestic Product) is not an appropriate measure for welfare. Instead, an alternative aggregate welfare measure that includes some account of natural capital [*27] could be one starting point to provide an 'easy' but fuller picture to broaden the public discourse.

We believe waste reduction in the food system and beyond to be one appealing angle to build public support for environmentally sound behavior. For example, reducing food waste both reduces consumption while enhancing energy efficiency and thus reduces emissions stemming from the food system, only one of many important sources of GHG emissions that can make up a proactive solution to address climate change and health related issues simultaneously [24].

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